Stopped Light and Image Storage by Electromagnetic Induced Transparency

What is Electromagnetic Induced Transparency(EIT)?

- EIT is a coherent optical nonlinearity which renders a medium transparent over a narrow spectral range. Extreme dispersion is also created within this transparency window which leads to slow light. In other word, it is a quantum interference effect that permits the propagation of light through an otherwise opaque medium.

How do they do it?

- When a control laser is fired at the crystal, EIT turns it the opaque crystal transparent. A second light source is beamed into the crystal before the control laser is shut off, returning the crystal to its opaque state. This leaves the light trapped inside the crystal, and the opacity of the crystal keeps the light trapped inside from bouncing around, effectively bringing light to a full stop. The energy of the light has been stored inside the crystal and convert into the corresponding atomic spin excitations. These atomic spins can maintain coherence (data integrity) for around a minute, after which the light pulse/image fizzles. To get the light back out of the crystal, the control laser is turned on, and the spin excitations are emitted as photons.

Applications

- Light-based memory that preserves quantum coherence, such as polarization and entanglement, may lead to the creation of a long-range quantum network.
- The technique can be potentially used in spatially multiplexed quantized memories at ultra long storage durations and single photon storage which increase the density of information can be stored.

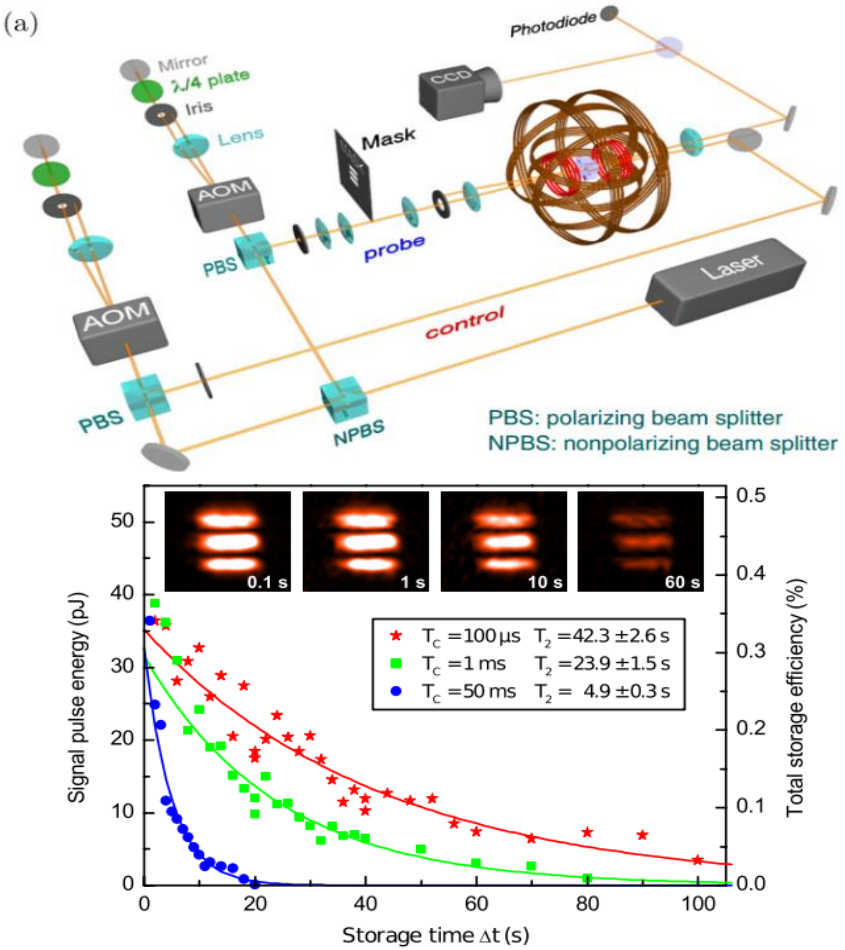

FIG. 4 (color online). Signal pulse energy and retrieved images vs storage time. The three data sets correspond to different cycling times in the dynamical decoupling sequence: $T_C = 100\ \mu$s, $T_C = 1$ ms, and $T_C = 50$ ms. The data are fitted by exponential decays. Dynamical decoupling at the fastest cycling time results in a storage duration of $T_2 = 42.3$ s ($1/e$ time). The insets show the results of image storage and retrieval in the setup, with storage times Δt of 0.1, 1, 10, and 60 s (from left to right). For image storage, we used a decoupling sequence with cycling time $T_C = 100\ \mu$s.